27 April 1955

MEMORANDUM FOR: THE RECORD

SUBJECT : Sound Modulation, Modification and Reproduction Device

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1. On 12 April 1955 the undersigned visited the Princeton Research Laboratories of RCA to discuss the feasibility of the fabrication of speech as had been proposed by [redacted] Present at this conference were [redacted] Vice President of Research, RCA, Princeton; [redacted] Director of RCA, Princeton; and [redacted] Head of the Acoustics Division. [redacted] is on the Board of Directors of the Acoustics Society of America and is a recognized authority in this field having published several text books in Acoustics.

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2. This group was first asked about the feasibility of fabricating or synthesizing a speech sound track so that if it were played back it would appear to have been made by any selected individual. It was the consensus of opinion that although this might seem theoretically possible, it would be impracticable to do for several reasons. [redacted] pointed out that it is almost impossible to visually read a sound track since what appears to be different sound patterns may actually sound the same to the ear. As a simple example, he cited the case of a fundamental tone with a third harmonic; the resulting combination of such tones would appear quite different depending upon the phase displacement between the tones but yet the ear would detect no difference. RCA has tried in the past to draw the simplest of sound tracks but the results upon play back have been very disappointing. In one case, they drew the track for a pure note, i.e. one having a sine wave shape. When this was played back, [redacted] said there was a superimposed gurgle sound. He attributes this to the almost impossible task of drawing the wave shape sufficiently accurately. Any inaccuracies show up in effect as noise in the resultant play back. If a signal to noise ratio of 40 db is required, then the sound track must be drawn with an accuracy better than one part in a hundred.

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3. To further illustrate the difficulties involved in trying to fabricate a sound track, [redacted] cited as an example some work RCA did several years ago. They were investigating the possibility of using a printing press method of reproducing a sound track rather than the usual photographic method.

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Attempts were made to make line cuts from an actual sound track. When prints from these line cuts were played back, the results were so noisy and the quality so poor that RCA abandoned this effort. It should be noted that the line cuts they used were about the best that could be obtained since they were made by the American Bank Note Company.

4. The RCA group was also asked about the possibility of piecing together a speech from component words from old sound tracks whether on film or magnetic tape. They agreed that this could be done but said the results would not be very convincing since they know of no method for effectively changing the emphasis on words. They have had considerable experience of "dubbing" in the records put out by RCA, but they feel that this is much simpler than trying to build a whole speech out of just words and phrases.

5. Because of RCA's vital interest in the recording and broadcast field, they have devoted considerable time and money to fabricating sound by any and all means. At the present time, both Bell Telephone Laboratories and RCA are working along somewhat similar lines though their end purposes are different. RCA has had some success in synthesizing music since this is much easier than the singing voice or speech. In this process, the music in elemental periods of time is analyzed into certain characteristics, i.e., frequency, intensity, growth, decay, portamento, wave form, vibrato, and deviation. Each of these characteristics for each short period of time is recorded on a punched tape. Later, this coded paper record is fed through an elaborate synthesizing equipment out of which comes a sound that resembles the original. It is hoped that after they have had sufficient experience, they will be able to make up these coded paper tapes directly without having to start with a given sound. As noted above, at the present time RCA is confining this work to the synthesizing of music, but the next step will be to try to synthesize the singing voice. They suggested that we approach them in two or three years about the problem of speech synthesizing by this method. At the present time, there is no analysis equipment available anywhere that would enable them to make a coded paper record of speech. They were unwilling to give any real estimates of the cost involved in this problem, but indicated that it would be on the order of a magnitude of one million dollars.

6. In conclusion, the RCA group wanted to know why we did not use an imitator to solve our problem since this would be by far the most practical method.

Distribution:
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